Appendix I: Acronyms and terms

accretion – growth of solid bodies through collisional aggregation of smaller bodies.

achondrite – meteorites that lack chondrules (stony and iron meteorites).

Agglutinate – melted material (glassy) found in lunar regolith

Alkali suite – rock suite identified in the Apollo samples consisting of relatively high Na and K contents (and more ferroan)

AMN – Antarctic Meteorite Newsletter (issued by JSC, KT)

angrite – achondritic meteorites consisting of dipopside-rich pyroxene, olivine and plagioclase, with a roughly basaltic composition.

angular momentum – a property of rotating systems that depends upon mass and its distribution, angular velocity, and radius. The angular momentum of the Earth-Moon system is contained in the Earth's rotation and the Moon's orbital motion.

anorthite – the calcium –rich end member of the plagioclase feldspar mineral series; $CaAl_2Si_2O_8$

anorthosite – an igneous rock made of > 90% plagioclase feldspar.

ANSMET – Antarctic Search for Meteorites, funded by U. S. National Science Foundation; led by William Cassidy and Ralph Harvey.

Apollo – NASA manned missions to the Moon in 1969-1972, which returned rock samples to Earth (at NASA Johnson Space Center)

ARES – Astromaterials Research and Exploration Science at the Johnson Space Center

AU – the mean distance between the Earth and Sun (1.496×10^{13} cm).

basalt – a fine-grained, dark colored igneous rock comprised primarily of pyroxene, olivine, feldspar and glass.

"blue ice" – Locations in Antarctica where samples were recovered (appendix IV)

- ***ALHA*** – Allan Hills region of Antarctica
- ***Asuka*** – Asuka Mountains
- ***EETA*** – Elephant Moraine
- ***MAC*** – Macalpine Hills
- ***MET*** – Meteorite Hills

MIL – Miller Range

PCA – Pecora Escarpment

QUE – Queen Alexandra Range

Yamato – Yamato Mountains

BM(NH) – British Museum of Natural History, now The Natural History Museum, London.

breccia – a rock comprised of coarse, angular mineral or rock fragments embedded with a fine-grained matrix

bulk silicate Earth – see "primitive upper mantle"

cataclysm – event proposed for the Moon and inner solar system whereby a heavy flux of material caused a heavy bombardment of impactors at about 3.9 Ga

chalcophile element – an element with a preference for sulfide minerals

CHINARE – Chinese Antarctica Research Expeditions

chondrite – the most abundant class of stony meteorites that contain chondrules

clast – rock fragment found within another rock such as in a breccia

Clementine – mission to the Moon providing elemental maps and other data

clinopyroxene – mineral of the pyroxene group such as diopside ($CaMgSi_2O_6$) or pigeonite ($(Ca,Mg,Fe)_2Si_2O_6$).

compatible element – a minor or trace element which partitions readily into crystalline rather than melt phases.

Copernicus – young crater on the near side of the Moon

core – dense, metal- or sulfide-rich central region of a planet.

cosmogenic isotopes – Isotopes produced by interaction of high-energy cosmic-rays with elements in sample.

Crisium – large basin on the near side of the Moon

crust – outer, highly differentiated region of a planet.

cumulate – a plutonic igneous rock composed chiefly of crystals accumulated by sinking or floating in a magma.

DaG – Dar al Gani, Libya, where many meteorites have been found

deflation – wind erosion area

Dho – Dhofar, Oman, where many meteorites have been found

differentiation – the process by which planetary bodies develop concentric zones that differ in chemical and mineralogical composition.

diogenite – achondrite meteorite comprised of orthopyroxene and minor amounts of olivine and chromite.

dunite – a peridotite comprised of > 90% olivine, with accessory pyroxene, chromite or plagioclase.

dpm – disintegrations per minute

educational thin section set – JSC, BM(NH) and NIPR all have sets of thin sections of meteorites, with educational pamphlets, for use by educational institutions.

ejection age – the sum of the exposure age and terrestrial age, the time since the sample was ejected from the Moon

EMPA – electron microprobe analysis

escape velocity – the speed an object must attain to escape from the gravitational field of another object.

eucrite – a basaltic meteorite composed essentially of feldspar and clinopyroxene

exposure age – The time interval a small body (~1m) spends in space as measured by radionuclides generated by high energy cosmic rays.

extinct isotope – a radioactive isotope that existed when the solar system formed, but with too short of a half-life to allow detectable amounts to remain now.

FAN – ferroan anorthosite – ancient anorthosites found among the Apollo and lunar meteorite suites

feldspar – a group of aluminous silicate minerals, with K-, Na- and Ca-bearing end members.

Feldspathic highlands terrane (FHT) – large terrane on the Moon made primarily of feldspar-rich material

Ferroan anorthosite (FAN) – ancient anorthosites found among the Apollo and lunar meteorite suites

fractionation – the separation of chemical elements from an initially homogeneous state into different phases or systems.

fractional crystallization – formation and separation of mineral phases of varying composition during crystallization of a silicate melt or magma, resulting in continuous change of composition of the magma.

fugacity – a thermodynamic function used instead of pressure in describing the behavior of non-ideal gases.

fusion crust – thin glass coating found on outer surface of meteorite due to heating by atmospheric entry

g – gram (also kg = kilogram and mg = milligram etc.)

Ga – 1,000,000,000 years

GPa – Giga Pascals (unit of pressure)

gabbro – a coarse-grained, dark igneous rock made up chiefly of plagioclase (usually labradorite) and pyroxene. A coarse-grained equivalent to a basalt.

garnet – a group of minerals with the general formula $X_3Y_2(SiO_4)_3$, in which X = Ca, Mg, Mn or Fe^{2+}, and Y = Al, Fe^{3+}, and Cr^{3+}.

genealogy diagram – Diagram that shows the relationship of rock splitting and allocations. The number before the comma is called the generic sample and the number after the comma is the "daughter" split.

giant impact theory – the theory that the Moon formed from material ejected into Earth orbit during an impact between a large impactor and the proto-Earth.

gravitational instability – condition in which slight rearrangements or concentrations of a relatively uniform distribution of mass can, by their gravitational effect, initiate substantial further contraction of mass into even more localized concentrations.

GRS – gamma ray spectroscopy

HED – Howardite, Eucrite, Diogenite. Large group of achondrites, related by mineralogy and petrology – howardites are brecciated mixtures of eucrites (basalt) and diogenites (opx).

High titanium basalt – class of lunar basalts with very high Ti content, compared to other lunar basalts (and especially compared to terrestrial basalt)

Highly siderophile element (HSE) – see noble metals. Also, defined by having metal/silicate partition coefficients at 1 bar > 10,000

howardite – a type of basaltic achondrite that is brecciated.

I_s/FeO – an index for maturity of lunar soils; the ratio of Measurement of Single-Domain, Nanophase Fe^0 (I_S) to FeO

ICP-MS – inductively coupled plasma mass spectrometry

IDMS – isotope dilution mass spectroscopy

INAA – instrumental neutron activation analysis

ilmenite – an oxide mineral with the composition $FeTiO_3$

Imbrium – large basin on the near side of the Moon

impact melt – melted rock that forms during impact of one body with another (common ion the Moon)

impact parameter – A term relating to the geometry of a collision between two spheres; it is the offset between the spheres' centers projected perpendicular to the line of approach.

inclination – the angle between the plane of a planet's orbit and the ecliptic (Earth's orbital plane), or a satellites orbit and its planet's equator.

incompatible element – a minor or trace element which partitions readily into the melt phase rather than crystalline phases.

interstitial – Area between the other major mineral phases.

isochron – a line on a diagram passing through plots of samples with the same age but differing isotope ratios.

isotopes – atoms of a specific element which differ in number of neutrons in the nucleus; this results in different atomic weights, and slightly differing chemical properties.

iron meteorite – a class of meteorite composed mainly of iron or iron-nickel metal.

komatiite – an MgO-rich rock thought to have formed by large percentages (20-30 %) of melting of the Earth's mantle. Found mainly in the Archean period of Earth history.

JARE – Japanese Antarctic Research Expedition

JSC – Lyndon B. Johnson Space Center, Houston, Texas 77058

katabatic wind – The wind that blows off of the Antarctic continent.

KREEP – An acronym for a lunar crustal component rich in potassium (K), the rare earth elements (REE), phosphorus (P), and other incompatible elements.

Lagrangian points – the five equilibrium points in the restricted three-body problem. Two of the Lagrange points (L_4 and L_5) are located at the vertices of equilateral triangles formed by the two primaries (e.g., Sun and Saturn, or Saturn and satellite) and are stable; the other three are unstable and lie on the line connecting the two primaries.

late veneer – in heterogeneous accretion theory, the late addition of material to a planet after a metallic core has formed.

liquidus – the line or surface in a phase diagram above which the system is completely liquid.

lithophile element – an element tending to concentrate in oxygen-containing compounds (silicates) as opposed to metal or sulfide.

lithosphere – an outer shell of a planet which has high rock strength and undergoes brittle deformation.

lherzolite – Two pyroxene rock, plutonic.

Low Ti basalt – class of lunar basalts with low Ti content, compared to high Ti lunar basalts (but still high compared to terrestrial basalt)

Luna – Soviet unmanned missions to the Moon that returned samples robotically

lunar capture theory – the hypothesis that the Moon was gravitationally captured by the Earth.

lunar cataclysm – the hypothesis that the Moon underwent a heavy bombardment period at approximately 3.9 Ga.

lunar fission theory – the hypothesis that the Moon was formed by separation or fission from the Earth.

lunar co-accretion theory – the hypothesis that the Moon and Earth accreted together.

Lunar Prospector – mission to Moon that included GRS instrument for elemental mapping

Ma – 1,000,000 years

MGS – magnesian suite rocks of the Moon

MWG – Meteorite Working Group. U. S. advisory panel to NSF/NASA/Smithsonian.

magma ocean – a globally extensive layer of magma on a planet or moon which consists of > 50% melt.

magmatic inclusion – small recrystallized glass inclusions usually found in early-formed olivine or chromite crystals (presumably trapped magmatic liquid)

magnesian perovskite – a mineral with the formula $MgSiO_3$ which is stable at high pressures (> 250 kb as exist deep with the Earth's mantle).

magnesiowüstite – an oxide with the formula (Mg,Fe)O; likely to be stable in Earth's lower mantle.

majorite – a component of garnet that is stable at high pressures and temperature in which no aluminum is present – only silica. It has the general formula of $(Mg,Fe)_4Si_4O_{12}$.

mantle – the zone of a planet beneath its crust and above its core.

mare basalt – basalts that form the lunar maria, which are the dark colored areas on the Moon.

mascon – Regions on the Moon of excess mass concentrations per unit area identified by positive gravity anomalies and associated with mare-filled multi-ring basins.

maskelynitization – Shock event that converts plagioclase into isotropic phase.

mesosiderite – stony-iron meteorites that consist of a brecciated mixture of iron-nickel metal and silicate minerals and pieces of gabbro and basalt.

mesostasis – Fine-grained mineral mass found interstitial to major minerals.

mineralogical mode – the mineral percentages, usually expressed as volume percent

"mineral" separate – An attempt to obtain a concentration of one mineral phase after powdering the rock and using various mechanical means (e.g. heavy liquids for density difference).

moment of inertia – a quantity related to the density distribution within a planet, specifically, the tendency for an increase of density with depth.

NEA – Northeast Africa

NIPR – National Institute Polar Research, Tokyo, Japan

noble gases – the rare gases helium, neon, argon, krypton, xenon and radon.

noble metals – Gold (Au), rhenium(Re) and the platinum group elements, platinum (Pt), rhodium (Rh), ruthenium (Ru), iridium (Ir), osmium (Os) and palladium (Pd).

norite – a rock type (found among Apollo samples) consisting of orthopyroxene and feldspar

nuclides – atoms characterized by the number of protons (Z) and neutrons (N). The mass number (A) = Z + N; isotopes are nuclides with the same number of protons, but differing numbers of neutrons; isobars have the same mass number (A) but different numbers of protons (Z) and neutrons (N).

NWA – North West Africa. Meteorites usually purchased from nomads in Morocco, but probably found in Algeria or even further east in Sahara.

olivine – a common silicate mineral within Earth's upper mantle and chondritic meteorites, with the general formula of $(Mg,Fe)_2SiO_4$.

ophitic – Texture of basaltic rock where pyroxene completely encloses plagioclase and other phases.

orbital resonances – orbital locations where pairs of orbital frequencies are in ratios of small whole numbers.

Orientale – large basin on the far side of the Moon

orthopyroxene – an orthorhombic member of the pyroxene mineral group, with the general formula of $(Mg,Fe)_2Si_2O_6$.

pallasite – stony-iron meteorites comprised of roughly equal amounts of olivine and iron-nickel metal. They are thought to be pieces of the core-mantle boundary of a small diffferentiated planetesimal.

partition coefficient – the ratio of the concentration of a trace element in one phase to its concentration in a second phase with which it is in equilibrium. Phases can be solid or liquid, metals or silicates.

percolation – the process by which a liquid settles through a solid matrix.

periclase – the mineral MgO.

peridotite – an igneous rock comprised of mainly pyroxene and olivine

picrite – high MgO, and usually olivine-bearing, basaltic rocks thought to be derived by melting of peridotite.

plagioclase – the calcium and sodium-bearing mineral series within the feldspar group.

planetesimal – bodies from millimeter to about a kilometer in size that are believed to have formed during the early planet-forming process.

plateau age – The age obtained from the $^{39}Ar/^{40}Ar$ spectrum as function of release temperature.

plutonic – a term applied to igneous rocks which have crystallized at depth, usually with coarsely crystalline texture.

poikilitic – Texture of igneous rock where small granular crystals are irregularly scattered without common orientation in a larger crystal of another mineral.

porosity – the volume percentage of a rock (or other material) that is occupied by voids or fluid.

ppb – parts per billion (by weight) – also ng/g

ppm – parts per million (by weight) – also μg/g

ppt – parts per trillion (by weight) – also pg/g

precession – a slow, periodic conical motion of the rotation axis of a spinning body.

pre-terrestrial – The history of the sample before entry into the Earth's atmosphere - as judged by location with respect to fusion crust.

primitive upper mantle – estimated composition of Earth's mantle after core formation, and before continental crust formation.

Procellarum – large basin on the Moon

Procellarum KREEP Terrane (PKT) – large KREEP-rich terrane on the near side of the Moon

radiogenic – a term referring to an isotope having been formed from a radioactive parent.

rare earth element (REE) – a collective term for the elements with atomic number 57-71, or the lanthanide series.

rare gases – see the noble gases

refractory element – an element that vaporizes at high very high temperatures, such as U, Al, Ca and the REE.

resonance – selective response of any periodic system to an external stimulus of the same frequency as the natural frequency of the system.

RNAA – radiochemical neutron activation analysis (generally superior to INAA, because of use of internal standard

Roche Limit – the critical separation between two bodies with no tensile strength at which tidal forces are so strong that the smaller body is torn apart; for the Earth and Moon, this distance is about 2.9 Earth radii.

SaU – Sayh al Uhaymir, Oman

SELENE – SELenological and ENgineering Explorer; A Japanese robotic mission to the Moon scheduled for launch in August 2007.

SEM – Scanning electron microscope

semimajor axis – half the length of the major axis of an orbit (its greatest diameter).

short-lived radionuclide – see extinct nuclide

siderophile element – an element which preferentially enters the metal phase ("sidero" = iron, and "phile" = loving).

silicate – a mineral or compound whose crystal structure contains SiO_4 tetrahedra.

SIMS – Secondary Ion Mass Spectroscopy

SMART-1 – Robotic mission to the Moon funded by the European Space Agency (ESA); Small Missions for Advanced Research in Technology

Smithsonian – see USNM below

solar nebula – the primitive disk-shaped cloud of dust and gas from which all bodies in the solar system originated.

solidus – the line or surface on a phase diagram below which the system is completely solid.

SPA (South Pole–Aitken basin) – largest lunar basin and located in the south polar region

SPH – smoothed particle hydrodynamics.

spinel – a group of oxide minerals with similar physical and chemical properties and with the general formula of AB_2O_4.

TEM – transmission electron microscope

terrestrial age – Time interval that meteorite has spent on Earth (for example, can sometimes be determined by determination of carbon 14)

trace element – an element found in very low (trace) amounts – 100 ppm or less.

troctolite – rock type (found among Apollo samples) consisting of olivine and plagioclase feldspar

Tycho – fresh young crater on the southern part of the near side of the Moon

USNM – United States National Museum, also called the Smithsonian Institution. Washington D.C. Specifically, the Department of Mineral Sciences is a great source of research samples.

viscosity – the resistance that a fluid system offers to flow when it is subjected to a shear stress. It is a measure of the internal friction that results when velocity gradients exist within a system.

VLT (very low titanium basalt) – class of lunar basalts with very low Ti content, compared to other lunar basalts (but still high compared to terrestrial basalt)

volatile element – an element with a low vaporization temperature such as the alkalis (K, Na) or Pb.

"whole-rock" – Term used for a small sample (50 mg-2 g) of a rock used to determine the chemical composition of the "whole" specimen. Generally selected to be representative of the "whole", but, obviously, NOT the whole rock.

XRD – X-ray diffraction

XRF – X-ray fluorescence

Young's modulus – the proportionality constant between stress (force per unit area) and strain (change in length per unit length) for an elastic material. In cgs units it is expressed in dynes cm^{-2} or lbs ft^{-2}.